

A Program on the Development of Domestic Tanning Materials*

By R. W. FREY

Inroads by man and disease are steadily depleting our supplies of established tanning materials. This trend has been definitely recognized in recent years but is treated with surprising indifference except perhaps on occasions when it is brought into sharp focus by world disturbances that conceivably might jeopardize our access to foreign sources.

Not more than fifty years ago practically all the vegetable tanning materials used by our leather industry were of domestic origin. Although statistics are not available for an exact calculation, it can be stated, conservatively, that today about one-half of these raw materials comes from foreign shores.

Chestnut wood, of course, is our most important domestic raw tanning material. It contributes at present about two-thirds of our domestic supply of tannin for making leather. The passing of the American chestnut tree through the ravages of the blight is now a sad reality. Looking into the near future when important quantities of the wood of this tree are no longer available, the matter of our home supplies of tannin may well take on more serious aspects unless replacements are developed in the meantime. It is estimated that aside from chestnut wood only about one-sixth of our total tanning material requirements now comes from domestic sources. Chestnut trees resistant to the blight that has killed the American chestnut stand are being studied by the Division of Forest Pathology of the Bureau of Plant Industry in cooperation with various agencies including the Bureau of Agricultural Chemistry and Engineering and the Soil Conservation Service. Manufacturers of chestnut extract are cooperating in this work and have made some forest plantings. This is a long-time project, the outcome of which must be awaited before the practicability of large-scale plantings can be determined.

The aggregate value of tanning materials is low as compared to that of many other raw material commodities. This may explain in part the apathy shown toward the further development of sources of tannin. The true value and importance of vegetable tanning materials, however, is not reflected alone by the price they bring. In the light of our present knowledge and practices the vegetable tanning materials occupy a key position in an important branch of our leather industry, since they are essential for the making of certain classes of leather, including especially the heavy leathers.

Leather is a basic commodity. Its importance in the life and welfare of a nation cannot be overemphasized. Leather is a daily necessity for the comfort, convenience, and protection of our people in times of peace and indispensable in war. Because of their role in the making of leather and our increasing dependence upon foreign supplies, tanning materials are classed in this country among the military critical raw materials. A forward-looking program for national welfare, therefore, demands the maintenance of a safe measure of economic and industrial independence in the production of leather through the development of more adequate home supplies of tanning materials.

Promising approaches to the carrying out of this program would appear to lie in the cultivation of highly tanniferous plants to be harvested as crops; the utilization of certain waste barks and other agricultural waste products; and the discovery and development of plants not now recognized as commercial sources of tannin. From a research standpoint, the possibilities in tannin crops are particularly intriguing because of the mutual advantages they offer to both the leather industry and agriculture. A successful culmination would assure supplies of needed raw materials for a basic industry, while providing at the same time benefits to agriculture in new crops and, hence, new sources of income; means to diversify use of the soil, thus reducing acreage now raising surplus products; and plants to promote better land-use practices, as in the prevention of soil erosion.

With these advantages in mind, the Bureau of Agricultural Chemistry and Engineering, the Bureau of Plant Industry, and the Soil Conservation Service, U. S. Department of Agriculture, working with certain State Agricultural Experiment Stations, have initiated recently a cooperative program of research on the development of new domestic tanning materials, preferably as new farm crops. Your meeting here appears an opportune time to tell you briefly about work under way and what is conceived by this program, not only that you may be informed, but also that your constructive suggestions and collaboration might be solicited.

At present all the tanning materials in this country are gotten from wild sources. In several parts of the world, however, the cultivation of tanning materials has become firmly established. This is especially true of the growing of wattle for tanbark in South Africa, sumac in Sicily, gambier in the Far East, fruit pods in India and Central and South America, and various materials in the British possessions. Increasing attention has been given in recent years to the possibilities in tannin crops, particularly by those countries heavily dependent upon foreign supplies. Of late, experiments on the growing of sumac and other tanniferous plants in Ethiopia and former Czechoslovakia have been reported.

At present there are no actual data that would throw light on the probable returns to be anticipated from the cultivation of tannin-bearing crops in

this country. There is perhaps a rather general attitude that it cannot be done economically or profitably. Certainly no definite position in this regard can be soundly taken until the problem has been thoroughly studied on a scale sufficiently extensive to yield basic data and adequate information. The evidence indicates that the problem is truly worthy of the attention of research. The concept alone of a multiple-product crop to help share planting, growing, and harvesting costs may easily paint a much more favorable economic picture.

Because it is new, the cultivation of tannin crops necessitates the acquiring of many original detailed facts pertaining to cultural, economic, geographic, climatic, and agricultural conditions and their careful weighing for a successful outcome. These include study of plant varieties, strains, and their progeny; optimum locations for growth and access to consuming centers; labor supplies; land values; production costs; yield of tannin and co-products; and the leather-making value of the tannin. A broad program of research on this basis is contemplated and is now partly under way.

Obviously, one of the first steps is the selection of those plants that are to be studied. Plants in which the tannin is concentrated in the roots, leaves, and fruits would appear to offer the most promise for crop production, although this generalization may not hold true invariably. One difficulty immediately encountered in the critical selection of native plants is the lack of data on the flora of the United States from the standpoint of their possible value as tanning materials. Such information, if available, would supply at once a means at least for preliminary selection. An important part of the program in its earliest stages, will be the acquiring of data on the tannin content of authentic specimens from especially those plants not now recognized as tanning materials. In this connection it might be informing to cite the results of an analysis of a sample of the bark of *Pithecellobium dulce* recently collected at the Plant Introduction Garden of the Bureau of Plant Industry, Coconut Grove, Florida, from a tree estimated at not over fifteen years old. This bark is known as camanchile, or perhaps more correctly guaymuchil, in Mexico and the Philippines. On the moisture-free basis, the Florida bark contained 29.8 per cent tannin and 8.6 per cent non-tannins, giving an unusually high purity of 77.6 calculated on soluble solids. These results definitely place this material among those deserving further consideration, and thus illustrate the value of such information.

At present attention is being directed particularly toward sumac and canaigre, but it is planned to include other materials as the program is expanded. In this connection, especially because of their history and the experiences of South Africa, one naturally thinks of the wattles. It is hoped that in the near future experimental studies can be initiated under orchard or crop conditions with some of the wattles, or perhaps plants of another species having general characteristics closely resembling those of wattle.

A number of the acacias, well known for yielding barks rich in tannin, have been introduced into this country and grown for many years, especially in California. Analyses have been reported showing over forty per cent tannin in the bark of young trees of *Acacia decurrens*, *mollissima*, and *pycnantha*, grown in California. No systematic studies, however, have been made in the United States of the tanbark wattles grown under cropping conditions, so that essential data on planting, raising, and harvesting costs and on yield and quality of the bark might be obtained.

Among the specialties, the pod tanning materials would appear to deserve careful consideration, because of both the very high tannin content associated with them, and the fact that they often have much sought after properties. This group would include such materials as algarobilla, divi-divi, cascalote, and tara, or similar fruits derived perhaps from some of the extremely large number of species of the genus *Caesalpinia*. Another sound reason for directing attention to this group is that most of the materials in it yield a pyrogallol tannin. Aside from chestnut wood and sumac, there is no important pyrogallol tanning material in sight in the United States today.

By way of generalizations a number of other materials, including particularly the mangrove and Eucalyptus trees, might be mentioned. It is believed, however, that the foregoing will provide sufficient elucidation for the moment.

Studies are now under way on both wild and cultivated domestic sumac. The virtues of sumac, and especially Sicilian sumac, as a tanning material are too well known by you to need amplification here. Sicily seems to have an unusually favorable combination of climatic, soil, and labor conditions together with a suitable type of sumac for the production of a leaf of high quality. In the United States sumac apparently has never been propagated commercially except for ornamental purposes, although its high tannin content has always attracted attention. The sumac industry in this country has depended entirely upon wild stock and as gathered and handled from this source domestic sumac has not compared favorably with the Sicilian product. Preliminary observations from experiments in progress on propagation and gathering have shown that the quality of domestic sumac can be greatly improved. With material from this work, experimentally tanned leathers have been obtained that were essentially equal in color to those gotten with Sicilian sumac. Cultivation studies no doubt will lead to further improvement through selection of the best varieties and the development of better methods of harvesting and curing.

Surveys are being made of wild plants in a number of locations to study tannin content and growth conditions for selection of the most suitable species for propagation, to find favorable locations where production might be profitable, and to locate planting stock. Considerable data have been obtained thus far on sumacs in Virginia, Maryland, Iowa, and Texas. A

similar survey is planned this summer for the southeastern states. The data on Texas sumacs are to be published soon. They are of particular interest in showing a tannin content of over thirty per cent in all leaf samples of *Rhus copallina* and *Rhus trilobata*.

Wide variations in the tannin content of wild sumac plants, even when growing within a very limited area, are frequently encountered. For example, leaves of *Rhus copallina*, L., from plants all growing within 200 to 300 feet of each other, were found to range from 21 per cent to 39.4 per cent in tannin content.

Cultivated plants from both wild rootstock and seed are being grown at Arlington, Va. and elsewhere to study methods of propagation and harvesting and to acquire information on tannin and crop yields. After proper treatment to insure germination, seed has produced a good stand and made splendid growth in both 1938 and 1939. With but one exception, the tannin content of leaves from seedlings grown at Arlington, Va. has been low. Arlington may not be a favorable location since leaves from seedlings grown in Iowa have been found to contain as much tannin as the parent plants.

The studies on propagation from seed are gradually yielding interesting and important fundamental data. For example, seed from the same species, *Rhus copallina*, gathered at different places and all planted in one plot at Arlington have produced leaves showing a wide variation in tannin content, of from 16.0 per cent to 27.8 per cent. Propagation by seed has several advantages, but it apparently will not be satisfactory until there is developed a fairly pure strain of seed that will produce plants uniformly high in tannin.

Propagation by rootstock has resulted in good stands. However, the labor of digging the roots and replanting is greater than for gathering and sowing seed. Also the roots cannot be kept long after digging without loss of vitality. One-year old plants from rootstock appear thus far to contain in general nearly as much tannin as the parent plants if grown under comparable conditions. Leaves containing up to 41 per cent tannin have been obtained from plants grown from transplanted *Rhus copallina*, L., rootstock.

In collaboration with the cooperative research conducted jointly by the Soil Conservation Service and the Iowa State Agricultural Experiment Station, work is in progress in Iowa on the study of the sumacs, not only as tannin bearing plants, but as a means for conserving soil particularly through the prevention of erosion. Some species of sumac have a shallow, spreading root system that extends for considerable distances and from which other sprouts develop. Grass or other vegetation will grow over this root system readily. A fundamental part of the Iowa program includes also the study of the influence of genetics and environment upon the tannin content of sumacs, using individuals of known history and different types of soil.

Canaigre (*Rumex hymenosepalus*, Torr.) is native to southwestern United States and Mexico. Its roots are comparatively rich in tannin and have

been used for centuries by the Indians and Mexicans for tanning. Canaigre is a fascinating plant with an intensely interesting history. It had at one time a rather brilliant but short career. Between 1868 and 1905 much attention was devoted to the propagation, harvesting, and processing of canaigre roots and over fifty publications have appeared on canaigre. Most of this work was done by the Agricultural Experiment Stations of Arizona, California, New Mexico, and Texas. A serious effort was made to commercially develop canaigre as a tanning material, including factory production of canaigre extract at Deming, New Mexico. It is also recorded that during 1891 and 1892 the Southern Pacific Railroad handled 370 carloads of sliced canaigre roots consigned to Europe.

Just why canaigre failed is not clear. One important reason would appear to be the comparatively rapid exhaustion of wild stock without materialization in the meantime of adequate production by cultivation. A rather long expensive haul to the consuming markets, together with the inability to prevent spoilage of canaigre and its extracts were perhaps other contributing factors.

Much has transpired during the past forty or fifty years to bring about a more favorable outlook for the development of canaigre. Leaving entirely aside the influence of diminishing supplies of native tanning materials, there have been tremendous strides made in the science of agriculture, supported by a high degree of mechanization, whereby large scale operations of planting, cultivating, and harvesting can be carried out at low costs. Better and more adequate transportation facilities have been developed. Marked advances have been made in the technology of tanning extract production, whereby high yields of a uniform product containing very little water can be produced at lower operating costs. By combining all of these developments in the most advantageous way there would appear to be grounds for the belief that ultimately canaigre can be developed successfully as a tanning material.

The program of research on canaigre is now in its third year. In the first part of this work canaigre roots from different sources were collected for analysis. These showed a wide range in tannin content of from 10 per cent to 35 per cent on the moisture-free basis. Agronomic studies to determine conditions for optimum production and yields are under way. These have included experimental plot plantings in New Mexico, Texas, and several southeastern states. From these plantings new roots have been obtained for re-planting and laboratory studies.

Data are being obtained on the adaptability of the soil and climate of various locations to the growing of canaigre. Preliminary plantings have already shown a wide variation in the suitability of different areas. Some have given yields so low that failure would be unavoidable. At others, yields have been obtained which, if they could be realized in commercial plantings

would practically assure success. The importance of location studies and the need for extending them is thus clearly emphasized.

Progeny studies are being conducted in which the succeeding generations from each of 89 selected parents are being examined to determine yields and tannin content. As these data are accumulated they will form, it is hoped, a basis for the selection of high-tannin, high-yield strains of canaigre.

Some of the laboratory studies in progress have as their principal objective the preparation of commercially valuable tanning extracts and the separation and development of co-products. In addition to about from 20 to 30 per cent tannin, air-dried canaigre roots contain considerable quantities of starch and sugars. In some cases as much as 25 per cent starch and 20 per cent of readily soluble sugars have been found. This composition of canaigre presents several extremely interesting possibilities. If all of its water soluble constituents are extracted at one time a very low purity extract with a high content of fermentable material can be obtained. On the other hand, if most of the water soluble nontannin constituents are first removed by fractional extraction, an extract of rather high purity results. Thus a series of extracts, covering a fairly wide range in their tanning characteristics, is possible from this one material. Starch as such, or fermentation products of starch and the sugars present, are among the possible co-products.

The real evaluation of canaigre extracts as tanning materials lies in the kind of leather that they will make, how they will blend with other materials, and what conditions they will set up in the liquors of the tannery. This will involve the making of many experimental leathers and their examination. It is expected that this phase of the work will be taken up soon. While for the moment no detailed information can be offered, some preliminary experiments have indicated definitely a number of interesting possibilities in the leather-making properties of canaigre.

The studies on the cultivation of sumac and canaigre have produced thus far, not opinions and viewpoints, but many facts to show that the conditions governing yields in terms of both the bulk crop and the quantity of actual tannin are but little understood. Until there is more real knowledge concerning these factors and their control to insure satisfactory yields, the commercial cultivation of these materials cannot be undertaken with any assurance of success. This situation should be forcibly emphasized. Premature ventures may result not only in material losses to investors but also in serious repercussions that may prove disastrous to efforts that otherwise might lead to a successful realization of tannin crops.

It should also be stressed that there is no cause for alarm over an immediate, acute shortage of tanning materials. Definitely this situation is not now contemplated. The program is obviously one of long-range research looking into the future. A part of the program is now actually under way. Some of it is still, however, entirely prospective. A successful pursuit of the

subject will require not only much time, patience, and many laborious experiments but also the constructive aid and cooperation of the tanner and his technical personnel, the agricultural scientist, and the farmer.

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Discussion

G. W. SCHULTZ: Dr. Frey and his co-workers are certainly to be congratulated on presenting the aspects of a problem which apparently is vital to all of us. We all believe that the development of a potential supply of domestic materials will be highly desirable, and especially so in the case of a national emergency. I feel that the problem as presented is primarily one of economics, and this, of course, is a question that should be, and is, very vital to us as practical tanners.

The thought that has occurred to me is this: it is rather notorious that in this country we are unable to produce anything from the soil that will compete in foreign markets. Such is not the case, however, in industry. The products of our plants do compete—and compete successfully in foreign markets. It occurs to me that what will happen when we sell the farmer on the idea of raising a crop such as would be necessary in the case of canaigre and possibly sumach is this: he may start out and, after his first year, find that he has not been able to make enough to retire and he will immediately become concerned, start a lobby in Washington, which will very much concern some of our politicians; and the result of all this concern will be that we will have a rather high tariff imposed on raw tanning materials.

Some of us believe that this will be highly undesirable. We feel that it is necessary to the progress of our industry that we be able to produce cheaper, in fact, in order for our industry to survive at all we may be compelled to do so. In order to increase the consumption of leather and prevent the replacement of leather with certain substitutes, it seems that it is very necessary to be able to lower the price of leather.

I do not know that there is anything more I can add at this time to the discussion. I understand we are somewhat in a hurry, and I will leave the remainder of the discussion to Mr. Oberlander.

T. F. OBERLANDER: I saw the samples of extracts that Dr. Frey had, and also the leather, and it strikes me that in this program we are not particularly competing with quebracho and chestnut but are opening up a field of new tanning materials. To my mind, one of the outstanding possibilities of this

is that we have here an opportunity of modifying the tannin to suit our particular needs. In the past we have had to take raw materials as produced in their native state and the tanner has combined these to suit his particular purpose. However, the leather samples that I saw indicate that there is a possibility, for instance, in the case of canaigre, of producing one extract which will give a mild, mellow piece of leather, and, by suitable processing, produce an extract from the same roots which is very similar to chestnut or mangrove bark. That is important, and I think that American industry must reach the point where they are not so much interested in their individual pocketbooks as they are in the general economic condition of the country.

G. D. McLAUGHLIN: I would like to ask Mr. Watson what action or what thought the Tanners' Council have in mind in the face of this situation which we know exists.

M. A. WATSON: Following Mr. Oberlander's statement of negligence, I can say that we have probably been negligent. We have discussed this problem with Dr. Frey a good many times; and I have had him outline what is being done. We are certainly anxious to see action. We have done whatever we could to assist it—although this has been very little, I must say.

With respect to tanning materials in general, some of you may know that the chemical industry has had a committee for the last eight or nine months working with the Army and Navy Munitions Board to determine the supplies available here for possible crucial needs in the next few years. I think this would tie into that general program. The report that the Chemical committee made (and I will say we did a good deal of statistical work for the committee) was reasonably optimistic on supplies for any needs that might develop in the next few years. But for the long term, I really am not competent to speak.

F. L. HILBERT: I do not have a question to ask but a little comment I would like to make on the interest and value of this subject. In the South, in connection with paper making, for instance, it is quite customary to cut down only the large long leaf pine trees and leave a great many small ones, as well as the small limbs and branches on the ground to waste and rot. Now there is a large paper company in Louisiana that has made up its mind not to allow such wanton waste to go on. The wood which was formerly burned and wasted they now use for paper making and have built up one of the most successful mills in the South. Those small pieces and branches they found make just as good paper pulp as the wood from the large trees; and now they do not wait, as formerly, for the trees to come to full growth before cutting. The same thing is equally true in regard to some of our tannin bearing trees, like oak, hemlock, and chestnut. It is possible to take not only the trunks and limbs but also the small branches and use the wood up more economically. In regard to quebracho, every part of the tree, trunk, limbs, branches, and roots are rich in tannin and all yield good extract.